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Detection of microwave spin pumping using the inverse spin hall effect

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Abstract

We report on the electrical detection of the dynamical part of the spin-pumping current emitted during ferromagnetic resonance using inverse spin Hall effect methods. The experiment is performed on a YIG|Pt bilayer. The choice of yttrium iron garnet (YIG), a magnetic insulator, ensures that no charge current flows between the two layers and only the pure spin current produced by the magnetization dynamics is transferred into the adjacent strong spin-orbit Pt layer via spin pumping. To avoid measuring the parasitic eddy currents induced at the frequency of the microwave source, a resonance at half the frequency is induced using parametric excitation in the parallel geometry. Triggering this nonlinear effect allows us to directly detect on a spectrum analyzer the microwave component of the inverse spin Hall effect voltage. Signals as large as 30 μV are measured for precession angles of a couple of degrees. This direct detection provides a novel efficient means to study magnetization dynamics on a very wide frequency range with great sensitivity. © 2013 American Physical Society.

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